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ABSTRACT

The study reported in this paper was designed to describe the differences between the reading-difficulty levels of primary textbooks used in first-semester freshman general studies courses and the reading skills of the students enrolled in those courses, and to compare the Flesch Reading Ease Formula with the SMOG Grading Formula. Separate sections of the paper introduce the study, review germane literature, describe the procedures used in conducting the investigation, analyze the statistical treatment of the data gathered for the study, and discuss findings, conclusions, and implications of the study along with recommendations for future research. A selected bibliography of relevant publications is included; appendixes list the textbooks used in the study, explain how to use the two readability formulas, and present an interpolation of Flesch scores. Numerous tables are provided. The major finding of the study was that most of the textbooks were written on a level significantly above the reading-ability levels of the students who were to use them. No statistically significant difference was found between the two reading formulas. (GW)

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THE READING ABILITY OF COLLEGE FRESHMEN COMPARED WITH THE READABILITY OF COLLEGE TEXTBOOKS

by

DICKIE LEE FOX

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CS004015

A Research Project conducted at
East Texas State University,
Commerce, Texas
December, 1977

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Chapter 1

INTRODUCTION

Textbooks are considered to be an essential part of teaching in colleges and universities. The majority of college courses have required textbocks. According to Cline (1972:33), one of the problems confronting both students and instructors is whether or not the textbooks are within the scope of the reading abilities of the students. Belden (1962:139) further stressed this dilemma of matching textbooks to students' reading abilities:

> If course materials are on a level above the reading skills of the students, frustration, anxiety and failure result. Without doubt, the relationship between the difficulty of material and the reading ability of the students presents one of the most pressing problems for those who rely upon printed materials for learning experiences.

Cline (1972:35) also suggested that textbooks were written to impress the author's colleagues rather than for the student audience for which they were intended. The American Textbook Publishers Institute (1949:88) stressed the importance of the textbook author's insuring that his material fit within the reading capabilities of the students who would use his text.

If instructors know the readability levels of

the textbooks they have chosen for their courses in relation to the reading-ability levels of their students, much of the frustration encountered in teaching could be lessened. While there have been many studies on readability of textbooks and reading abilities of students, the majority of these have been concentrated on the elementary and secondary levels with a paucity at the college level (Cline, 1972:34). A review of the literature revealed that the following readability and reading-ability studies have been conducted at the college level: Major and Collette (1961), Belden and Lee (1962), Bently and Galloway (1961), Burford (1969), Brownrigg (1969), and Froelich (1970). A majority of the studies concluded that the textbooks and other reading materials were written on a higher level than the students were capable of reading.

STATEMENT OF THE PROBLEM

This study was designed to determine the readability level of primary textbooks used in selected first-semester freshman courses and to compare the results with the reading abilities of first-semester freshmen enrolled at East Texas State University during the 1977 fall semester. Readability levels of the textbooks were examined by using the following standardized tests: the Flesch Reading Ease Formula and the SMOG Grading Formula. The Nelson-Denny Reading Test was

employed to assess the reading-ability levels of the students.

PURPOSE OF THE STUDY

If the instructors of first-semester freshman courses at East Texas State University know the readability levels of the textbooks and other course materials and determine the reading-ability levels of their students, they will be prepared to understand and handle the students' reading assets and limitations and to make adjustments in teaching techniques as required. Therefore, students can adequately function and achieve success. It is vital to the student's success that the instructor understand the uniqueness of the student in relation to the kind of learning experience the student will encounter in his courses.

It was felt that many instructors would use to their advantage such knowledge as the reading-ability levels of their students and the readability levels of their textbooks in order to facilitate and improve instruction. This project was undertaken so that such information could be made available to the faculty for the purpose of developing more effective instructional techniques as well as gaining insights into the reading problems possibly being encountered by their students.

A secondary purpose of this study was to compare the SMOG Grading Formula with the Flesch Reading Ease

Formula. While the Flesch Reading Ease Formula has proved to be the most reliable and widely used formula, there were not enough data available to indicate the usefulness of the SMOG Grading Formula as a readability tool (Rakes, 1972:22).

DELIMITATIONS OF THE STUDY

This study was limited to the primary textbooks used in the first-semester freshman courses that were assigned a semester credit value of not less than three semester hours, were listed as daytime courses, were not part of a special program, were not foreign languages, and were not preceded by prerequisites. The selected courses were chosen from the first-semester freshman courses listed under the General Studies Program in the East Texas State University General Catalog, 1977-78 (East Texas State University, 1977:40-41). The General Studies Program included elective courses. Textbooks from selected elective courses were examined to give a broader coverage of the types of textbooks used by first-semester freshmen.

The students tested for reading ability were limited to those first-semester freshmen who had fewer than ten semester hours of college credit and were enrolled as full-time daytime students at East Texas State University. The total number of students participating in the study was determined on the basis of the

size of the freshman class enrolled for the 1977 fall semester. Students were chosen randomly by class from the courses listed in the 1977 fall semester class schedule as first-semester freshman courses. The formulas used to assess the readability levels of the textbooks were limited to two standardized formulas: the Flesch Reading Ease Formula and the SMOG Grading Formula. The reading-ability testing of the students was limited to the Nelson-Denny Reading Test.

MAJOR ASSUMPTIONS

Assumptions were as follows:

1. The twenty-five textbooks evaluated in the investigation were representative of the textbooks used in first-semester freshman courses.

2. The students tested were representative of first-semester freshmen enrolled at East Texas State University during the 1977 fall semester.

3. The Flesch Reading Ease Formula and the SMOG Grading Formula were reliable and valid instruments for assessing reading difficulties of textbooks.

4. The Nelson-Denny Reading Test, Form C, was a reliable and valid instrument for measuring students' reading abilities.

DEFINITION OF TERMS

The following terms were used in this study:

Disabled reader: A reader who is at the secondary level or higher who reads two to three or more grade levels below his expected reading grade-level placement. A disabled reader cannot read textual materials without special help or remediation (Spache, 1976:5; Burmeister, 1974:288). Burmeister (1974:287-88) explained that the two- to three-year grade-level span is necessary to ascertain that there is a real reading disability. According to Roswell and Natchez (1964:1), a student can be considered a disabled reader if "there is a significant discrepancy between his reading level and his intellectual potential."

Expected reading level: A predicted level of reading capacity based on a student's grade-level attainment.

First-semester freshman: A student who is enrolled full time in college and who has fewer than ten semester hours of college credit.

Full-time daytime student: A student enrolled for not fewer than twelve semester hours in courses that meet between the hours of 7:30 a.m. and 4:30 p.m., Monday through Friday.

Readability: The ease or difficulty of reading material which may be referred to as grade-level equivalent (Rakes, 1972:8).

Readability formula: A predictive device used to estimate the probable success of a reader in reading

and understanding a sample of writing (Klare, 1963:34-37).

Reading level: The level of achievement reached by a reader, generally defined in terms of grade or stage of growth (Good, 1959:445).

Reading level, capacity: The level at which a reader exercises all the reading ability for which he has capacity (Good, 1959:445).

Reading level, instructional: The level at which a reader can read so as to learn effectively; the level at which the student may be instructed through reading (Good, 1959:445).

Textbook: A book dealing with a definite subject of study, systematically arranged, intended for use at a specified level of instruction, and used as a principal source of study material for a given course (Good, 1959:605).

QUESTIONS TO BE ANSWERED

This descriptive study was designed to answer the following questions:

1. How many students read at grade levels six through fifteen as measured by the Nelson-Denny Reading Test?

2. What percentage of the students reads at grade level thirteen, what percentage reads above grade level thirteen, and what percentage reads below grade level thirteen?

3. What are the arithmetic mean, median, and mode of the students' reading-ability scores?

4. How many of the textbooks are rated at grade levels six through sixteen as measured by the Flesch Reading Ease Formula?

5. What percentage of the textbooks is rated at grade level thirteen, what percentage of the textbooks is rated above grade level thirteen, and what percentage of the textbooks is rated below grade level thirteen as determined by the Flesch Reading Ease Formula?

6. What are the arithmetic mean, median, and mode of the textbook readability levels as determined by using the Flesch Reading Ease Formula?

7. How many of the textbooks are rated at grade levels six through seventeen as measured by the SMOG Grading Formula?

8. What percentage of the textbooks is rated at grade level thirteen, what percentage of the textbooks is rated above grade level thirteen, and what percentage of the textbooks is rated below grade level thirteen as determined by the SMOG Grading Formula?

9. What are the arithmetic mean, median, and mode of the textbook readability levels as determined by using the SMOG Grading Formula?

10. What is the correlation between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability

level of the textbooks as measured by the SMOG Grading Formula?

11. How many of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula?

12. What percentages of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula?

13. How many of the students read above, below, or on the same readability level of the textbooks as measured by the SMOG Grading Formula?

14. What percentages of the students read above, below, or on the same readability level of the textbooks as measured by the SMOG Grading Formula?

15. As measured by the Flesch Reading Ease Formula, how many of the students read two or more grade levels below the readability levels of the textbooks, and how many read three or more grade levels below the readability levels of the textbooks?

16. As measured by the Flesch Reading Ease Formula, what percentage of the students reads two or more grade levels below the readability levels of the textbooks, and what percentage reads three or more grade levels below the readability levels of the textbooks?

17. As measured by the SMOG Grading Formula, how many of the students read two or more grade levels

below the readability levels of the textbooks, and how many read three or more grade levels below the readability levels of the textbooks?

18. As measured by the SMOG Grading Formula, what percentage of the students reads two or more grade levels below the readability levels of the textbooks, and what percentage reads three or more grade levels below the readability levels of the textbooks?

STATEMENT OF THE HYPOTHESIS

For purposes of this study, only one hypothesis was formulated. It is as follows: There is no statistically significant difference between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula.

RESEARCH PROCEDURES

This investigation included a review of literature gathered from books, professional periodicals, Educational Resources Information Center documents, dissertations, and dissertation abstracts. Special areas emphasized in the review of literature were reading ability, readability, comparisons that have been made between the reading level of students and the readability of textbooks in colleges and universities, comparisons and readability studies that have involved elementary and secondary

schools, and investigations which have included application of the Nelson-Denny Reading Test as well as the Flesch Reading Ease Formula and the SMOG Grading Formula.

Selection of Subjects

This research was conducted during the 1977 fall semester and utilized 317 first-semester freshman students enrolled in first-semester freshman General Studies courses at East Texas State University during the fall semester of 1977. The sample size was determined by using a statistical table developed by Krejcie and Morgan (1970:608). The investigation utilized full-time daytime students; no exclusions were made on the basis of age, sex, marital status, national origin, dominant language, or other factors. Students with visual handicaps were not tested.

The twenty-five textbooks selected for the study were representative of the primary textbooks used in first-semester freshman General Studies courses. Textbooks were selected from the textbooks identified by the various departments offering first-semester freshman General Studies courses as the textbooks used in those courses (see Appendix A). The General Studies Program included elective courses. Textbooks from selected elective courses were examined to give a broader coverage of the types of textbooks used by first-semester freshmen.

Data Collection and Recording

Readability levels of the twenty-five textbooks were calculated during September and October of 1977. The assessing of readability levels of the textbooks was done manually by the investigator's utilizing the Flesch Reading Ease Formula and the SMOG Grading Formula.

The Flesch Reading Ease Formula required the collection of twenty-five one-hundred-word samples at regular intervals throughout the textbook. The words and sentences were counted. The Flesch Reading Ease Formula converted the counts to grade-level equivalents (see Appendix B for a detailed description of the computation of the instrument). The SMOG Grading Formula analysis required the collection of three samples--one from near the beginning, one from the middle, and one from near the end of the textbook. The samples consisted of ten consecutive sentences in which the polysyllabic words were counted, and the estimated square root was determined. Three was added to the square root in order to yield the grade-level equivalent (see Appendix C for a detailed description of the computation of the instrument). The Nelson-Denny Reading Test was administered to the 317 first-semester freshmen at the beginning of the fall semester; the answer sheets were hand scored immediately.

ORGANIZATION OF THE REMAINDER OF THE STUDY

Chapter 2 presents a review of germane literature, and Chapter 3 describes the procedures used in conducting the investigation. An analysis of the statistical treatment of the data gathered for the study is presented in Chapter 4. The summary, conclusions, and recommendations are included in Chapter 5.

Chapter 2

REVIEW OF RELATED LITERATURE

The purpose of this chapter is to present a review of significant literature and research germane to the role of textbooks, readability assessment of textbooks, and the reading abilities of students in relation to the readability levels of their textbooks. The related literature presented in this chapter is divided into three sections: the role of the textbook; the readability aspect of textbook selection with emphasis on comprehension, readability assessment, and the use of readability data; and the reading capacities of students in relation to the readability levels of their textbooks.

THE ROLE OF THE TEXTBOOK

The textbook is firmly entrenched in the American educational process at all levels. According to Hall-Quest (1918:1), "the teacher and the textbook are the two pillars of instruction." The fact that the majority of college courses have required textbooks bears out Hall-Quest's statement. Black (1967:3), in discussing the role of the textbook, stressed the following:

> Textbooks are still the single most important teaching tool. Put all your new teaching tools

> together--the projectors, the films, the teaching machines--and they're just a drop in the bucket compared to that old stand-by [sic], the textbook. Invariably, the textbook is the basis of every curriculum. To an overwhelming extent, it determines what will be taught and when.

The textbook has assumed an important and universal role in American education because it provides an orderly and compact arrangement of material, a ready reference tool, and a source of direction for application of the subject (Hall-Quest, 1918:5-9). The American Textbook Publishers Institute (1949:3) offered further support of the central role of the textbook in the instructional process: "Stop the supply of textbooks and you will discover how indispensable teachers consider them." The ubiquity of the textbook supports the claim cited by the American Textbook Publishers Institute (1949:4) that

> . . . the great majority of people who are responsible for education believe that the textbook is a highly important and essential element in the program of our schools and colleges.

TEXTBOOK READABILITY

The readability aspect of textbook selection emphasizes comprehension, readability assessment, and the use of readability data. Each of these emphases is discussed below.

Comprehension

Readability scores are expressed as a percentage of comprehension for a given grade level. For example, a

Flesch Reading Ease Formula grade-equivalent score refers to a 50 percent comprehension level (Klare, 1974-75:68). Readability formulas use comprehension as a criterion for validation and reliability. Most readability formulas are validated by using the McCall-Crabbs Standard Test Lessons in Reading as the standard of comprehension (Klare, 1974-75:66).

Good (1959:123) defined comprehension as "the act of understanding the printed or spoken language." Bloom and others (1956:204) further defined comprehension:

> This [comprehension] represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

Bloom and others (1956:89-90) divided comprehension into three areas: translation, interpretation, and extrapolation. Translation is putting communication into another form of communication or language. Interpretation involves the reordering of ideas in the mind of the individual. Extrapolation involves making predictions or inferences based on trends or tendencies.

Davis (1944:186) identified nine groups of basic reading comprehension skills:

> 1. Knowledge of word meanings
> 2. Ability to select the appropriate meaning for a word or phrase in the light of its particular contextual setting
> 3. Ability to follow the organization of a passage and to identify antecedents and references in it

4. Ability to select the main thought of a passage
5. Ability to answer questions that are specifically answered in a passage
6. Ability to answer questions that are answered in a passage but not in the words in which the question was asked
7. Ability to draw inferences from a passage about its contents
8. Ability to recognize literary devices used in a passage and determine its tone and mood
9. Ability to determine a writer's purpose, intent, and point of view, i.e., to draw inferences about a writer.

Comprehension has been defined as a set of complex language interpretation skills which the reader utilizes in the reading process. Most readability instruments assess readability level by using comprehension as the criterion.

Readability Assessment

Dale and Chall (1948:11), in defining readability, stated:

> In the broadest sense, readability is the sum total (including interactions) of all those elements within a given piece of printed material that affects the success which a group of readers have with it. The success is the extent to which they understand it, read it at optimum speed and find it interesting.

This definition places emphasis on three aspects of reading: comprehension, fluency, and interest. The primary thrust of this definition centers around reading comprehension. The speed at which a piece of printed material may be read and the motivational factors play secondary roles. These elements are not independent of one another; they act in concert to affect readability

(Gilliland, 1972:13).

Readability assessment is the matching of the reader with the textbook (Gilliland, 1972:12). Readability is assessment through the use of a readability formula or other readability-assessing technique. McLaughlin (1966:21) defined a readability formula as "a multiple linear regression equation which is claimed to predict readability from a small number of linguistic measures." Good (1959:471) also defined a readability formula as "a technique for determining the difficulty of reading materials, generally taking into account vocabulary and sentence length." Both definitions stated that readability is determined through the measurement of linguistic factors.

Linguistic factors for the purposes of readability assessment have been grouped into two primary factors: word difficulty and sentence difficulty (Klare, 1963:163-64). These linguistic factors are discussed as they are utilized in the readability instruments employed in this investigation.

The Flesch Reading Ease Formula measures readability in terms of word length and sentence length in a regression equation (Flesch, 1951:4). Klare (1963: 164-65) regarded the word as being "the most important unit" in readability study because "it is a natural unit of analysis in written material; . . . it accounts for the greatest amounts of variance in available factor

analysis of readability elements." The Flesch Reading Ease Formula uses the word factor in terms of average word length--word length being determined by the number of syllables in a word. Gilliland (1972:91) defined the use of the word as a readability factor:

> The word factor may be seen as a measure of semantic difficulty since syllable counts are a reflection of word length. The higher syllable counts tend to measure rarity of words and therefore difficulty of meaning.

The Flesch Reading Ease Formula uses sentence length in relation to a word. Gilliland (1972:91) described the effect of sentence length in determining readability as "a reflection of memory span, since the longer the sentence is, the more difficult it will be to remember the parts and so more difficult to understand." Sentence length and complexity of sentence structure are related. Longer sentences tend to be more complicated than short ones. The sentence length used in calculating the Flesch readability estimate is based on the number of words in a given passage in relation to the number of sentences in the passage. The Flesch formula assesses readability by utilizing the two most significant linguistic features found in printed material--word length and sentence length--in relation to one another.

The SMOG Grading Formula assesses readability through the use of word length and sentence length. The SMOG Grading Formula is simpler than the Flesch Reading

Ease Formula in that the number of sentences is held constant. In developing his formula, McLaughlin found that thirty sentences from the text to be assessed were a suitable number for the criterion of readability (Klare, 1974-75:79). McLaughlin (1969:640) felt that the primary indicator of readability was the length of words:

> In English, word length is associated with precise vocabulary, so a reader must usually make extra effort in order to identify the full meaning of a long word, simply because it is precise.

Concerning the use of the SMOG Grading Formula as a usable readability tool, McLaughlin (1969:645) stated:

> . . . that counting polysyllabic words in a fixed number of sentences gives an accurate index of the relative difficulty of various texts; and that the formula for converting polysyllable counts into grades gives acceptable results.

Use of Readability Data

The primary purpose of readability assessment is that of matching books and readers. According to Klare (1974-75:64), readability information determines "whether a particular piece of writing is likely to be readable to a particular group of readers." Klare (1963: 11) had previously stated that "readable writing is desirable and important for the reader's sake. If it is not readable to an intended reader, it is not readable." Gilliland (1972:14), quoting McLaughlin's (1969) study, further supported the importance of the reader in readability assessment when he stated that "readability must

be based on the characteristics of the readers, as it can be assumed that people will continue to read only that which they understand."

The importance of readability data has been identified as matching readers with books so that the readers can effectively read. Readability information can be used by instructors, textbook writers, and librarians. Instructors can utilize readability data to aid them in selecting textbooks appropriate to the reading skills of their students. Textbook writers can insure that their material is on the readability level of their potential readers by using readability assessments of their writing. Librarians can use readability information to aid a reader in the selection of books that are within the reader's ability range (Gilliland, 1972:15).

Mallinson, Sturm, and Mallinson (1954:616); Ekwall and Solis (1971:48); Bently and Galloway (1961: 383); and Feirer (1973:21) were just a few of the many researchers in the field of readability who specifically stressed the importance of the use of readability data in the selection of textbooks to insure that the textbooks were within the reading abilities of the students who would use them. Render and others (1975:34) summed up their investigation into readability of computer and business textbooks with the following recommendation concerning the use of readability information in textbook selection:

> Readability measurements offer us another criterion in considering a book for adoption. Given textbooks that are equal in subject content, approach, etc., we suggest that readability be used as the deciding factor in text selection. Readability offers an objective, statistically reliable measurement rather than having to rely upon subjective student feedback in evaluating a text.

READING CAPACITIES OF STUDENTS AND READABILITY OF TEXTBOOKS

Textbooks can either facilitate or hinder learning. Textbooks that are too difficult for the reader to effectively utilize can cause frustration, anxiety, and academic failure. The available literature indicated that much research has been focused on the readability of textbooks, the reading abilities of students, and the readability of textbooks in relation to the students who use them. The research into the readability problem can be divided into areas corresponding to the academic levels found in American education: elementary, secondary, adult, and higher education. The studies conducted at the higher education level can be divided into community or junior college level and senior college level. For the purposes of this investigation, the community college level and the senior college level have been considered as one group.

The following readability studies involving elementary and secondary school students and materials were reviewed: Yoakum (1945); Mallinson (1951); Mallinson, Sturm, and Mallinson (1950, 1952, 1954); D. A. Johnson

(1957); Bently and Galloway (1961); Strang (1965); Kline (1966); Ekwall and Solis (1971); Guthrie (1972); Bryant (1973); Landor (1973); Carver (1974); Harris (1974); and Duscher (1975). College level readability investigations reviewed were Major and Collette (1961), Belden and Lee (1962), Brownrigg (1969), Burford (1969), Froelich (1970), Meinkoth (1971), Cline (1972), Hiller (1974), Kurzman (1974), Render and others (1975), and Slovak (1975). Two studies germane to readability of materials in adult education were examined: Klevins (1972) and Rakes (1972).

Findings of Past Research

The general consensus of the majority of the investigations, regardless of level, was that the textbooks and other reading materials were written on a level far enough above the reading abilities of the intended readers so that they could not effectively use the textbooks as learning tools. Mallinson, Sturm, and Mallinson (1954:612), who conducted numerous investigations into the problem of reading difficulty of elementary and high school science textbooks, concluded that "the reading levels of many textbooks in science are too advanced for the students for whom they are written." They further stressed the limited value of textbooks that were written beyond the students' abilities. Kline (1966:220) recommended that textbooks used at a given level be written

for that level with consideration given to keeping the vocabulary of the textbooks within the reading abilities of the students for whom the textbooks were intended.

An investigation conducted by Kurzman (1974) to compare the reading abilities of college freshmen with their textbooks revealed that the average reading ability was at the ten-and-a-half-grade level. Twenty-four textbooks were evaluated by using the SMOG Grading Formula and were rated as follows: four at grade level thirteen, seven at grade level fourteen, five at grade level fifteen, six at grade level sixteen, and two at grade level seventeen. It was concluded that the textbooks were written at levels that were many grade levels in excess of the students' reading capabilities. The subjects were classified as reading two years below the expected college reading level. Kurzman (1974:14) quoted a study conducted by Halfter and Douglas, which revealed that "two-thirds of their entering college freshmen lacked reading skills required for academic success." An investigative conclusion reached by Hadley was also quoted by Kurzman (1974:14):

> . . . that 95 percent of college entrants lack adequate study skills and that a relatively small percent [sic] have reading speeds and comprehension skills adequate for preparation of their college assignments.

Kurzman (1974:20) recommended that readability data be used in conjunction with student reading ability data to insure that the textbooks were within the reading

capacities of the students.

Crooks and Smith (1957:54) examined twenty college science textbooks which they classified as fairly difficult to difficult according to the Flesch Reading Ease Formula scores. Crooks and Smith (1957:56) stated that "these teacher-popular books may be student terrors." This statement was based on the assessment of college students by Crooks and Smith (1957:55):

> Our college students are poor writers; freshmen are notoriously bad spellers; and students who cannot read well or understand the printed word are obviously at a disadvantage in college science courses. . . . Many college students fail because they are not able to read well.

They recommended that textbook authors and college science instructors take into consideration the reading skills of the students for whom the textbooks are intended.

Cline (1972:36) evaluated community college textbooks and students and found that 50 percent of the students read below seven of their textbooks. It was determined that the average reading-ability level was 12.6 and that, overall, 52 percent of the students had reading abilities below the readability level of the textbooks. Cline (1972:36-37) recommended that readability of textbooks be given high priority in textbook selection and that student reading ability be a consideration.

Render and others (1975) assessed the readability level of thirteen computer and business textbooks by

utilizing the Flesch Reading Ease Formula. It was determined that, although the books fell within the reading-ability range expected of college students, freshmen and sophomores would have difficulty in reading them (Render and others, 1975:34). Render and others (1975:34) recommended the use of readability assessment in the textbook-selection process.

Burford (1969:66), in a comparative study involving college freshmen and freshman earth science textbooks, found that 38 percent read below the reading-difficulty levels of the textbooks. It was concluded that because the students lacked sufficient reading skills in relation to the textbooks their academic achievement was influenced by their inability to read their textbooks. It was suggested that readability information be utilized in textbook selection (Burford, 1969:97). Burford (1969:97) emphasized the importance of textbook authors and publishers being aware of the potential reader's reading ability in relation to their textbooks' readability levels.

Summary of Findings of Past Research

The following is a summary of the literature reviewed that deals with past research into readability of textbooks as compared with the students who use them: The reviewed investigations indicated that the textbook is a primary teaching tool. The student's inability to

effectively comprehend his textbook, either because he is a poor reader or because the textbook is written at a level higher than his expected reading level, has been cited as a reason for academic failure. Textbooks have not been written with the potential reader's reading abilities as a consideration. Cline (1972:34) suggested that textbook writers tend to write more for peer approval than for the students who will use their textbooks. Researchers in the area of readability have stressed the importance of using readability data in the textbook-selection process to insure that the textbooks are within the reading capabilities of the students for whom they were intended. Stevenson (1937:663) and Mallinson, Sturm, and Mallinson (1952:630) recommended that the readability level of textbooks should be one year lower than the reading abilities of the students for whom the textbooks are intended.

Chapter 3

PROCEDURE

The primary objective of this descriptive investigation was to determine whether the textbooks used in first-semester freshman General Studies courses at East Texas State University met the needs of the students as far as readability was concerned. To accomplish this objective, the investigation was designed to describe the differences, if any, between the readability levels of the textbooks used in first-semester freshman General Studies courses and the first-semester freshmen enrolled in those courses. A secondary objective of this investigation was to determine whether a significant difference existed between the two formulas used to measure the readability levels of the textbooks.

This chapter describes procedures in gathering and analyzing the data. These procedures included selection of the subjects, selection of the textbooks, selection of the measuring instruments, computation of the readability formulas, administration of the tests, organization for analysis of the data, and treatment of the data.

SELECTION OF SUBJECTS

The population of students in this investigation consisted of the first-semester freshmen who were enrolled as full-time daytime students at East Texas State University during the 1977 fall semester. A sample of students was selected based upon the total enrollment of the freshman class for the 1977 fall semester. D. L. Johnson (1977), Director of Records and Reports at East Texas State University, reported the official freshman enrollment for the 1977 fall semester to be 1,770. This figure included all students classified as freshmen. Utilizing a table derived by Krejcie and Morgan (1970:608) from the formula for determining suitable sample sizes developed by the Research Division of the National Education Association ("Small-sample Techniques," 1960), the sample size was determined to be 317 first-semester freshmen.

The students were randomly selected by class section. Each day-class section of first-semester freshman courses listed in the 1977 fall schedule of classes at East Texas State University and not requiring a prerequisite, not listed as part of a special program, not designated as a remedial course, and not a foreign language course was assigned a number in order of listing in the bulletin. These numbers were drawn at random until the requirement for the sample size was met. Only the results of those students classified as first-semester

freshmen were included in this investigation.

SELECTION OF TEXTBOOKS

The textbooks which were evaluated in this investigation were the primary textbooks used in first-semester freshman General Studies courses at East Texas State University during the 1977 fall semester. The textbooks were identified by the various departments offering first-semester freshman courses as the primary textbooks used in those courses. In this investigation, twenty-five primary textbooks were examined for readability (see Appendix A). The General Studies Program included elective courses. Textbooks from selected elective courses were examined to give a broader coverage of the types of textbooks used by first-semester freshmen.

SELECTION OF MEASURING INSTRUMENTS

There were three measuring instruments selected for use in this study: the Nelson-Denny Reading Test, the Flesch Reading Ease Formula, and the SMOG Grading Formula. Each of the instruments is discussed in the paragraphs which follow.

Nelson-Denny Reading Test

Form C of the Nelson-Denny Reading Test was used to determine the reading-ability levels of the selected first-semester freshmen. The test was designed to assess

the three major elements of reading aptitude: vocabulary, comprehension, and reading rate. The test consisted of one hundred items for assessing vocabulary and thirty-six items to determine reading comprehension. It was a timed test requiring thirty minutes to administer--ten minutes for the vocabulary section and twenty minutes for the comprehension section. A total reading-ability score was computed by multiplying the comprehension score by two and adding it to the vocabulary score. According to Nelson and Denny (1973:3), the total score yields the best overall indicator of reading ability through the use of the Nelson-Denny Reading Test. The Nelson-Denny scores are given as raw scores, percentiles, and grade equivalents. Grade-equivalent scores were used in this investigation because they are expressed in a unit that affords simplicity and direct meaning and a basis for comparison between different tests (Nelson and Denny, 1973:31). The hand-scored self-marking answer sheets were used by the students to record their responses.

The Nelson-Denny Reading Test was selected as the instrument to assess the students' reading abilities because it has been one of the most widely used methods. Additionally, it was designed for use at the college level, and it has been standardized at the college and university levels (Nelson and Denny, 1973:24-25). The various editions of the Nelson-Denny Reading Test have

been used extensively since 1929 (Buros, 1972:587-88).

Flesch Reading Ease Formula

Two readability formulas, the Flesch Reading Ease Formula and the SMOG Grading Formula, were utilized to determine the grade-equivalent reading-difficulty levels of the twenty-five textbooks. These readability formulas were selected because they were suited to measure the readability levels of textual materials used at the college level. The readability scores of both formulas were expressed in grade equivalents, which provided a basis for comparison between the two formulas. The Flesch Reading Ease Formula has been used extensively in comparative readability studies. The SMOG Grading Formula was a relatively new readability formula which had not been widely used in studies. Gilliland (1972:95) stated that it lacked enough use to assess its acceptability as a readability-assessing instrument. The SMOG Grading Formula was selected in order that more data would be available concerning its use as a readability-assessing tool.

The Flesch Reading Ease Formula predicts readability through the difficulty of words and sentences. Semantic difficulty is determined through the number of syllables found in the words in the selected samples. The sentence length determines how difficult the materials are to comprehend. The Flesch Reading Ease Formula,

using the word and sentence as factors, measures a wide range of linguistic skills (Gilliland, 1972:91). The grade-level equivalent derived through the use of this formula refers to a 50 percent comprehension level (Klare, 1974-75:68).

The Flesch Reading Ease Formula correlated .7074 with the Standard Test Lessons in Reading developed by McCall and Crabbs (Klare, 1963:59). According to Klare (1963:32), the Standard Test Lessons in Reading is a set of graded reading passages that is "the most used and most adequate of available criteria for the construction of readability formulas." Powers, Sumner, and Kearl (1958:101) determined the standard error of the estimate of the Flesch Reading Ease Formula to be .85 grade levels. The error range of 1.71 grades was determined by converting the standard error of the estimate to a grade-level value and taking ± plus or minus two standard errors. The 1.71 grade-level figure defines the probable area in which the true grade-level equivalent falls (Powers, Sumner, and Kearl, 1958:101). Gilliland (1972:92) stated that most correlations were about .70 in the "numerous validation studies involving the Flesch Formula." According to Klare (1974-75:68), the Flesch Reading Ease Formula has become "one of the most widely used in the history of readability measurement."

SMOG Grading Formula

The SMOG Grading Formula assesses readability through the use of one factor: the length of words found in the samples. The more polysyllabic words, the more difficult the material. The SMOG Grading Formula takes into consideration both semantic and syntactic difficulties and their interaction (McLaughlin, 1969:640). The SMOG Grading Formula correlated .7130 with the Standard Test Lessons in Reading as the criterion (McLaughlin, 1969:642). The grade level derived by the SMOG Grading Formula is that which a reader needs in order to insure complete comprehension rather than the grade at which textual material can be read with understanding (Kurzman, 1973:6). The standard error of estimate of the SMOG Grading Formula readability predictions is 1.50 grades (Klare, 1974-75:80). According to McLaughlin (1969:643), the formula will predict the grade of a passage correctly within one-and-a-half grades in 68 percent of cases.

COMPUTATION OF READABILITY FORMULAS

In order to determine the readability grade-equivalent level of each textbook used in this study, two formulas were utilized: the Flesch Reading Ease Formula and the SMOG Grading Formula. The computation of these formulas is discussed in the paragraphs which follow.

Flesch Reading Ease Formula

In order to determine the readability grade-equivalent level of each textbook by using the Flesch Reading Ease Formula, the investigator counted words, sentences, and syllables. The analysis of each textbook involved twenty-five samples of one hundred or more words taken at regular intervals. Selections were made by dividing the number of pages in the textbook--exclusive of the table of contents, bibliography, index, and appendix pages--by twenty-five. The samples began with the first new paragraph on each of the designated pages. A page with no reading material was disregarded; the following page was chosen. Sentences in the sample were counted and recorded. Counted as sentences were strings of words that were units of thought; were grammatically independent; and ended with a period, question mark, exclamation point, semicolon, or colon. The number of syllables for one hundred words only were counted and listed. In order to determine the average sentence length, the total number of words in the sample was divided by the total number of sentences. The number of syllables per one hundred words was counted and recorded (Flesch, 1949:213-14).

A reading-ease score was computed for each sample. The average sentence length of the sample was multiplied by the constant 1.015. The number of syllables per one hundred words was multiplied by the constant .846. The

products of the two preceding steps were added, and that sum was subtracted from the constant 206.835. The resulting difference was the reading-ease score for an individual sample. The mean average reading-ease score of the samples indicated the reading-difficulty level of the book (Flesch, 1949:216).

A grade-equivalent level was determined for each textbook by converting the mean reading-ease score to a grade equivalent by utilizing a table specifically developed by Flesch for that purpose (Flesch, 1949:149). Flesch's grade equivalents are reported singly and combined: six, seven, eight through nine, ten through twelve, and thirteen through sixteen (see Appendix B for detailed steps). In order to facilitate ease of comparison, calculation, and interpretation, the combined grade equivalents were interpolated to yield single grade equivalents for grade levels that fell within each combined group (see Appendix D for calculation and explanation). It took approximately two hours to compute the readability level of each textbook by using the Flesch Reading Ease Formula.

SMOG Grading Formula

In order to determine the readability grade-equivalent level of each textbook by using the SMOG Grading Formula, the investigator counted ten consecutive sentences near the beginning of the textbook, ten

consecutive sentences in the middle of the textbook, and ten consecutive sentences near the end of the textbook. Any string of words ending in a period, question mark, or exclamation point was counted as a sentence. In the thirty selected sentences, words of three or more syllables were counted. Strings of letters or numerals beginning with a space and ending with a space or punctuation mark and having at least three syllables when read aloud in context were counted. Polysyllabic words that were repeated were counted each time they appeared in the selected sentences. The estimate of the square root of the number of polysyllabic words was taken. This was done by taking the square root of the nearest perfect square. Three was added to the approximate square root. This sum yielded the SMOG grade equivalent, which is the reading grade that a person must have reached if he is to understand fully the textbook assessed (McLaughlin, 1969:639) (see Appendix C for detailed steps). It took approximately ten minutes to calculate the readability level of each textbook by using the SMOG Grading Formula. These calculations were made during the 1977 fall semester.

ADMINISTRATION OF READING TEST

The Nelson-Denny Reading Test, Form C, was administered at the beginning of the 1977 fall semester to twenty-five first-semester freshman General Studies

classes in eight academic departments: Agriculture, Biology, Chemistry, History, Home Economics, Mathematics, Psychology, and Sociology. The test was administered by the investigator during the regular class time. All students present were tested regardless of their classification. Students who had been previously tested in other classes by the investigator were excused from repeating the test. Students with visual handicaps were also excused. The complete test required thirty minutes to administer--ten minutes for the vocabulary test and twenty minutes for the comprehension test. It was administered during a single class period, and the answer sheets of those students who identified themselves as first-semester freshmen were scored by the investigator. Data were recorded on a log sheet designed for that purpose and illustrating raw scores, percentile ranks, and grade equivalents for the various subparts of the Nelson-Denny Reading Test.

ORGANIZATION FOR ANALYSIS OF DATA

The data were organized for analysis following the scoring and recording of the Nelson-Denny Reading Test results and the computing of the Flesch Reading Ease Formula and the SMOG Grading Formula. The data were coded and keypunched on IBM cards to facilitate the analysis.

Reading Scores Collated

The Nelson-Denny Reading Test administered to the 317 students yielded four sets of scores: vocabulary scores, comprehension scores, total scores (vocabulary raw score added to the comprehension raw score), and reading-rate scores. Scores were expressed as raw scores, percentile scores, and grade-equivalent scores. The total grade-equivalent score was utilized in the analysis of the data.

The grade equivalent could range any tenth of a point between whole graded levels from grade level six to grade level fifteen-plus. The scores were grouped into one-grade classes for this analysis. Using these scores, the data were arranged in a frequency distribution with a class interval of one (see Table 1, page 48, and Table 2, page 50). The grade equivalents ranged in order from grade level six to grade level fifteen-plus. In order for percentages of students' reading levels to be determined at the various grade levels, a cumulative frequency, a percentage frequency, and a cumulative-percentage frequency for distribution of scores were obtained with a class interval of one (see Table 1, page 48). The mean, median, and mode were computed and recorded (see Table 3, page 52).

Flesch Readability Scores Collated

The Flesch Reading Ease Formula grade-equivalent

scores were reported singly and combined: six, seven, eight through nine, ten through twelve, and thirteen through sixteen. In order to facilitate computation and comparison, grade levels falling within the combined scores were interpolated by utilizing the reading-ease score of the textbook that fell within the range of reading-ease scores for that combined-score group.

The tabulations were illustrated in a frequency distribution, a cumulative frequency distribution, and a cumulative-percentage frequency distribution (see Table 5, page 54). The mean, median, and mode for the total scores were determined and reported (see Table 4, page 54).

SMOG Readability Scores Collated

The SMOG Grading Formula grade-equivalent scores are reported singly. The tabulations were illustrated in a frequency distribution, a cumulative frequency distribution, and a cumulative-percentage frequency distribution (see Table 7, page 59). The mean, median, and mode for the total scores were determined and reported.

TREATMENT OF DATA

In order to answer the questions and test the hypothesis, this descriptive study analyzed the reading abilities of 317 first-semester freshmen enrolled in

first-semester freshman General Studies courses and twenty-five primary textbooks used in those courses. Both the reading-ability scores of the students and the readability-level scores of the textbooks were reported in grade-level equivalents.

Questions Answered

In order to answer the questions formulated for this study, the following methods of data presentation have been used:

1. A frequency distribution reports the data necessary to answer the question concerning the number of students that reads at grade levels six through fifteen as measured by the Nelson-Denny Reading Test.

2. A frequency distribution and cumulative-percentage frequency distribution report the data necessary to answer the question dealing with the percentage of students that reads at grade level thirteen, the percentage that reads above grade level thirteen, and the percentage that reads below grade level thirteen.

3. The data necessary to answer the question about the arithmetic mean, median, and mode of the students' reading-ability scores are reported in a table.

4. A frequency distribution reports the data necessary to answer the question concerning the number of textbooks rated at grade levels six through sixteen as measured by the Flesch Reading Ease Formula.

5. A cumulative-percentage distribution reports the data necessary to answer the question concerning the percentage of the textbooks that was rated at grade level thirteen, the percentage that was rated above grade level thirteen, and the percentage that was rated below grade level thirteen as measured by the Flesch Reading Ease Formula.

6. A table reports the statistics necessary to answer the question treating the arithmetic mean, median, and mode of the textbook readability levels as determined by utilizing the Flesch Reading Ease Formula.

7. A frequency distribution reports the data necessary to answer the question dealing with the number of textbooks rated at grade levels six through seventeen as measured by the SMOG Grading Formula.

8. A frequency distribution and cumulative-percentage frequency distribution report the statistics necessary to answer the question concerning the percentage of textbooks rated at grade level thirteen, the percentage rated above grade level thirteen, and the percentage rated below grade level thirteen as measured by the SMOG Grading Formula.

9. The statistics necessary to answer the question dealing with the arithmetic mean, median, and mode of the textbooks, as determined by utilizing the SMOG Grading Formula, are reported in a table.

10. In order to answer the question dealing with

the correlation coefficient between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula, a Pearson product-moment coefficient of correlation was determined. A table reports this statistic.

11. A frequency distribution reports the data necessary to answer the question as to how many of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula.

12. A cumulative-percentage distribution reports the data necessary to answer the question concerning what percentages of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula.

13. A frequency distribution displays the data necessary to answer the question treating the total students who read above, below, or on the same readability level of the textbooks as measured by the SMOG Grading Formula.

14. A percentage distribution reports the data necessary to answer the question dealing with what percentages of the students read above, below, or on the same readability level as the textbooks according to the SMOG Grading Formula.

15. A frequency distribution displays the

statistics necessary to answer the question dealing with the number of students that reads two or more grade levels below the readability level of the textbooks and the number that reads three or more grade levels below the readability level of the textbooks as measured by the Flesch Reading Ease Formula.

16. The statistics necessary to answer the question concerning the percentage of students that reads two or more grade levels below the readability level of the textbooks and the percentage that reads three or more grade levels below the readability level of the textbooks, as measured by the Flesch Reading Ease Formula, are presented in a cumulative-frequency distribution.

17. A frequency distribution reports the data necessary to answer the question concerning how many of the students read two or more grade levels below the readability level of the textbooks and how many read three or more grade levels below the readability level of the textbooks as measured by the SMOG Grading Formula.

18. A cumulative-percentage distribution presents the data necessary to answer the question concerning what percentage of the students reads two or more grade levels below the readability level of the textbooks and what percentage reads three or more grade levels below the readability levels of the textbooks as measured by the SMOG Grading Formula.

Hypothesis Tested

In order to test the hypothesis that there is no statistically significant difference between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula, the t-test for independent samples was applied to the mean scores. The .05 level of confidence was judged to be significant.

Chapter 4

ANALYSIS OF THE DATA

A major purpose of this investigation was to describe existing differences between the difficulty of textbooks used in first-semester freshman General Studies courses and the reading abilities of students enrolled in those courses. A secondary purpose was to determine if a statistically significant difference existed between the Flesch Reading Ease Formula (Flesch) and the SMOG Grading Formula (SMOG). Students' reading abilities were compared by using percentage and ordinal scales. Statistics of the arithmetic mean, median, and mode for students' reading abilities were included in the results of the study. The assessment of readability difficulty of the textbooks included ranking both the ordinals and percentages for those items. The Nelson-Denny Reading Test, Form C, was used to determine the reading skills of the 317 first-semester freshmen. The Flesch formula and the SMOG formula were used to determine the readability grade level of the twenty-five textbooks examined in this study. The 317 first-semester freshmen involved in this investigation composed a statistically representative sample of the 1,770 freshmen enrolled at

East Texas State University during the 1977 fall semester. The twenty-five textbooks evaluated in this study were considered to be representative of the textbooks utilized in the first-semester freshman General Studies courses.

READING ABILITIES OF STUDENTS AND READABILITY OF TEXTBOOKS

The statistical results of the Nelson-Denny Reading Test are displayed in Table 1 and Table 2. Table 1 reports the initial grade-level placements of the student sample, illustrating the students who scored at each grade level and the percentage of the sample that scored at each grade level. These data indicated that 16.72 percent of the sample population read at grade level fifteen or above. The percentage of students reading at grade level fourteen was 11.68 percent. A total of 65 students, or 20.50 percent of the sample, read at grade level thirteen. There were 103 students, comprising 32.50 percent of the sample, who read at grade levels ten, eleven, and twelve. Students reading at grade levels nine and below composed 18.60 percent of the sample.

Table 2 shows the Nelson-Denny Reading Test scores arranged in a frequency distribution, a cumulative frequency distribution, and a cumulative-percentage frequency distribution. These data indicated that 48.90 percent of the sample population read at or above grade

level thirteen. The percentage of students reading at grade level thirteen was 20.50 percent. Students reading at grade levels twelve and below constituted 51.10 percent of the sample.

Table 1

Initial Grade-Level Placement of Student Population

Grade-Level Placement	N	% of Population
fifteen-plus	53	16.72
fourteen	37	11.68
thirteen	65	20.50
twelve	43	13.57
eleven	34	10.73
ten	26	8.20
nine	20	6.31
eight	15	4.73
seven	9	2.83
six	15	4.73
Total	317	100.00

Question 1

Question 1 was stated as follows: How many students read at grade levels six through fifteen as measured by the Nelson-Denny Reading Test? The frequency distribution in Table 1 displays these statistics.

Fifteen students read at grade level six, 9 at grade level seven, 15 at grade level eight, 20 at grade level nine, 26 at grade level ten, 34 at grade level eleven, 43 at grade level twelve, 65 at grade level thirteen, 37 at grade level fourteen, and 53 at grade level fifteen-plus. There were 162 students who read at grade levels twelve and below, 227 students who read at grade levels thirteen and below, and 90 students who read at grade levels fourteen and above.

Question 2

Question 2 was stated as follows: What percentage of the students reads at grade level thirteen, what percentage reads above grade level thirteen, and what percentage reads below grade level thirteen? Table 1, page 48, reports that 20.50 percent of the students read at grade level thirteen. According to Table 2, 28.40 percent read above grade level thirteen. Table 2 also indicates that 51.10 percent of the students read below grade level thirteen.

The Nelson-Denny Reading Test scores ranged from a grade-equivalent level of six (the Nelson-Denny Reading Test does not yield scores lower than grade level six) to grade level fifteen-plus. Only three students, or less than 1.00 percent of the sample, read lower than grade level six. These students' scores were included in the group reading at grade level six for

198 who were evaluated at grade levels twelve and above, 258 who scored at grade levels ten and above, 278 who scored at grade levels nine and above, and 59 who scored at or below grade level nine. A total of 39 students, or 12.29 percent of the sample, demonstrated reading skills at or below grade level eight. Students who read at grade levels nine, ten, eleven, and twelve totaled 123, or 38.81 percent of the first-semester freshmen tested. There were 155 students who scored at the college levels (grade levels thirteen, fourteen, and fifteen-plus). These students comprised 48.90 percent of the students tested.

Question 3

Question 3 was stated as follows: What are the arithmetic mean, median, and mode of the students' reading-ability scores? The arithmetic mean, or average score, was 12.23, indicating .78 percent of a grade level below grade level thirteen, the grade equivalent normally expected of college freshmen. The median reading-ability score for 317 first-semester freshmen was 12.89 grade levels. The mode for the distribution of reading-ability scores was 13.50 grade levels. These data are presented in Table 3. Exactly 65 students scored at grade level thirteen (see Table 1, page 48).

When the mean score of the students' reading abilities, as determined by the Nelson-Denny Reading

Table 2

Frequency Distribution of the Nelson-Denny Reading Test Scores for 317 Students in First-Semester Freshman General Studies Courses

Grade-Level Placement	Frequency*	Cumulative Frequency	Cumulative-Percentage Frequency
fifteen-plus	53	317	100.00
fourteen	37	264	83.28
thirteen	65	227	71.60
twelve	43	162	51.10
eleven	34	119	37.53
ten	26	85	26.80
nine	20	59	18.60
eight	15	39	12.29
seven	9	24	7.56
six	15	15	4.73
Total	317		

*N = 317; $\bar{X}$ = 12.23.

statistical purposes. Fifteen students were rated at grade level six. The statistics presented in Table 1, page 48, and Table 2 report frequencies, percentages, cumulative frequencies, and cumulative percentages. There were 53 students who scored at grade level fifteen-plus, 90 who were rated at grade levels fourteen and above, 155 who scored at grade levels thirteen and above,

Test, were compared to the mean readability of the textbooks, as measured by the Flesch formula, the data indicated that the students read an average of 1.77 grade levels below the mean of the textbooks. The Flesch mean was equivalent to grade level fourteen. The mean readability of the textbooks, as assessed by the SMOG formula, was 1.37 grade levels higher than the mean reading-ability score of the students. The SMOG mean was determined to be 13.60 grade levels.

Table 3

Comparisons of Arithmetic Means, Medians, and Modes of the Nelson-Denny Reading Test Scores and the Flesch and SMOG Readability Scores

Instrument	Mean	Median	Mode
Nelson-Denny Reading Test	12.23	12.89	13.50
Flesch Reading Ease Formula	14.00	14.00	14.00
SMOG Grading Formula	13.60	14.00	14.00

The median score of the students was determined to be 12.89, which was 1.11 grade levels below the median scores of the Flesch formula and the SMOG formula. The median score for both readability formulas was grade level fourteen.

The mode of the students' reading abilities fell within the interval designated for grade level thirteen. Because the data were grouped into whole grade-level

intervals, the mode was assigned the value of the middle of the class interval. The mode for the distribution was 13.50, which was half a grade level below the mode of the textbooks as measured by both formulas. The mode of both the Flesch and SMOG was grade level fourteen.

Question 4

Question 4 was stated as follows: How many of the textbooks are rated at grade levels six through sixteen as measured by the Flesch Reading Ease Formula? Table 4 presents the statistics for the textbooks in a frequency distribution, a cumulative frequency, and a cumulative-percentage frequency distribution; and Table 5 displays the grade equivalent for each textbook. Of the 25 textbooks evaluated, the grade-level equivalents of 24 fell within the Flesch college-level classification, or a group comprised of grade levels thirteen through sixteen. The remaining textbook was classified in the Flesch group of grade levels ten through twelve. To facilitate comparison with the results of the SMOG formula, the Flesch scores were interpolated (see Appendix D for calculation and explanation). Two of the textbooks were rated at grade level sixteen, 6 were rated at grade level fifteen, 9 were rated at grade level fourteen, 7 were rated at grade level thirteen, and only 1 was rated at grade level eleven. None of the textbooks was rated at grade level twelve.

Table 4

Frequency Distribution of the Flesch Reading Ease Formula Grade Equivalents for Textbooks Used in First-Semester Freshman General Studies Courses

Grade-Level Placement	Frequency*	Cumulative Frequency	Cumulative-Percentage Frequency
sixteen	2	25	100.00
fifteen	6	73	92.00
fourteen	9	11	68.00
thirteen	7	8	32.00
twelve	0	--	--
eleven	1	1	4.00
Total	25		

*N = 25; $\bar{X}$ = 14.00.

Table 5

Grade Equivalents of Books Used in the First-Semester Freshman General Studies Courses

Book	Flesch Assessment (Interpolated)*	SMOG Assessment**
1	fourteen	fifteen
2	fourteen	fourteen
3	fourteen	fourteen
4	thirteen	twelve

Table 5 (continued)

Book	Flesch Assessment (Interpolated)*	SMOG Assessment**
5	fourteen	fifteen
6	thirteen	ten
7	fifteen	fourteen
8	thirteen	twelve
9	fourteen	twelve
10	thirteen	twelve
11	fourteen	seventeen
12	sixteen	fifteen
13	fifteen	eleven
14	fifteen	fifteen
15	thirteen	thirteen
16	eleven	fourteen
17	fourteen	fourteen
18	fifteen	fourteen
19	sixteen	sixteen
20	fourteen	fourteen
21	thirteen	twelve
22	fourteen	fiftoen
23	fifteen	thirteen
24	fifteen	thirteen
25	thirteen	fourteen

*N = 25; $\bar{X}$ = 14.00. **N = 25; $\bar{X}$ = 13.60.

Question 5

Question 5 was stated as follows: What percentage of the textbooks is rated at grade level thirteen, what percentage of the textbooks is rated above grade level thirteen, and what percentage of the textbooks is rated below grade level thirteen as determined by the Flesch Reading Ease Formula? A total of 96.00 percent of the textbooks was rated at grade levels thirteen and above. Only 1 textbook, or 4.00 percent of the textbooks assessed by utilizing the Flesch formula, was rated below grade level thirteen.

The Flesch grade-level equivalent scores ranged from grade level eleven to grade level sixteen. The frequency and the percentage for each grade level are given in Table 6. Two textbooks, or 8.00 percent, were rated at grade level sixteen; 6 textbooks, or 24.00 percent, were rated at grade level fifteen; 9 textbooks, or 36.00 percent, were rated at grade level fourteen; and 7 textbooks, or 28.00 percent, were rated at grade level thirteen. Only 1 textbook, or 4.00 percent, was rated at grade level eleven; and none of the textbooks was rated at grade level twelve.

Question 6

Question 6 was stated as follows: What are the arithmetic mean, median, and mode of the textbook readability levels as determined by using the Flesch Reading

Table 6

Frequency and Percentage Distributions of Flesch Readability Scores

Grade-Level Placement	Frequency*	Percentage
sixteen	2	8.00
fifteen	6	24.00
fourteen	9	36.00
thirteen	7	28.00
twelve	0	--
eleven	1	4.00
Total	25	

*N = 25; $\bar{X}$ = 14.00.

Ease Formula? Table 3, page 52, presents a comparison of these measures of central tendency for the Flesch formula, the SMOG formula, and the Nelson-Denny Reading Test. The mean readability level of the textbooks, as assessed by the Flesch formula, was calculated to be at grade level fourteen, with the mean reading proficiency for the students at 12.23 grade levels. This placed the Flesch formula mean 1.77 grade levels above the mean reading ability of the students.

The median score of the textbooks rated by the Flesch formula was at grade level fourteen. The median reading-ability score of the students, gauged by the Nelson-Denny Reading Test to be 12.89 grade levels, fell

1.11 grade levels below the median score of the Flesch formula.

The Flesch mode was determined to be at grade level fourteen. Nine textbooks were determined to be at that grade-equivalent level. A difference of half a grade level existed between the mode of the textbooks and the mode of the students, which was 13.50 grade levels.

Question 7

Question 7 was stated as follows: How many of the textbooks are rated at grade levels six through seventeen as measured by the SMOG Grading Formula? Table 5, page 54, presents the grade equivalent for each textbook; and Table 7 presents the statistics in a frequency distribution, a cumulative frequency, and a cumulative-percentage frequency distribution. One textbook was rated at grade level seventeen, and 1 textbook was determined to be on grade level sixteen. Five textbooks were rated at grade level fifteen, 8 textbooks were rated at grade level fourteen, 3 textbooks were assessed at grade level thirteen, and 5 textbooks were rated at grade level twelve. One textbook was rated at grade level ten and 1 at grade level eleven.

Question 8

Question 8 was stated as follows: What percentage of the textbooks is rated at grade level thirteen,

Table 7

Frequency Distributions of the SMOG Grading Formula Grade Equivalents for Textbooks Used in First-Semester Freshman General Studies Courses

Grade-Level Placement	Frequency*	Cumulative Frequency	Cumulative-Percentage Frequency
seventeen	1	25	100.00
sixteen	1	24	96.00
fifteen	5	19	92.00
fourteen	8	11	72.00
thirteen	3	8	40.00
twelve	5	3	28.00
eleven	1	2	8.00
ten	1	1	4.00
Total	25		

*N = 25; $\bar{X}$ = 14.00.

what percentage of the textbooks is rated above grade level thirteen, and what percentage of the textbooks is rated below grade level thirteen as determined by the SMOG Grading Formula? Table 8 shows that 12.00 percent of the textbooks evaluated by the SMOG formula were rated at grade level thirteen. Another 60.00 percent of the textbooks were rated above grade level thirteen. Table 7 shows that 28.00 percent of the textbooks were

rated below grade level thirteen.

The SMOG grade-equivalent scores ranged from grade level seventeen to grade level ten. The frequency and percentage statistics for each grade level are given in Table 8. One textbook, or 4.00 percent, was rated at grade level seventeen. Likewise, 1 textbook was rated at grade level sixteen. Five textbooks, or 20.00 percent, were rated at grade level fifteen; 8 textbooks, or 32.00 percent, were rated at grade level fourteen; 3 textbooks, or 12.00 percent, were rated at grade level thirteen; 5 textbooks, or 20.00 percent, were rated at grade level twelve; 1 textbook, or 4.00 percent, was rated at grade level eleven; and 1 textbook, or 4.00 percent, was rated at grade level ten.

Table 8

Frequency and Percentage Distributions of the SMOG Grading Formula Readability Scores

Grade-Level Placement	Frequency*	Percentage
seventeen	1	4.00
sixteen	1	4.00
fifteen	5	20.00
fourteen	8	32.00
thirteen	3	12.00
twelve	5	20.00
eleven	1	4.00

Table 8 (continued)

Grade-Level Placement	Frequency*	Percentage
ten	1	4.00
Total	25	

*N = 25; $\bar{X}$ = 13.60.

Question 9

Question 9 was stated as follows: What are the arithmetic mean, median, and mode of the textbook readability levels as determined by using the SMOG Grading Formula? Table 3, page 52, presents the measures of central tendency for the SMOG formula. The SMOG mean readability score was 13.60 grade levels. This figure was 1.37 grade levels above the mean reading-ability score of the students.

The median readability score of the textbooks rated by the SMOG formula was grade level fourteen. The median reading-ability score of the students, which was 12.89, fell 1.11 grade levels below the median score of the SMOG formula.

The mode of the SMOG formula was determined to be at grade level fourteen. Eight textbooks were rated at that grade-equivalent level. A difference of half a grade level existed between the mode of the textbooks and the mode of the students, which was 13.50 grade levels.

Question 10

Question 10 was stated as follows: What is the correlation between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula? A Pearson product-moment coefficient of correlation was computed to determine the relationship between the Flesch readability scores and the SMOG readability scores. The computed r was .3478, which shows a low degree of relationship between the scores of the Flesch formula and the SMOG formula.

Question 11

Question 11 was stated as follows: How many of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula? Table 9 reports the readability levels of the textbooks and the reading-ability levels of the students in frequency distributions and percentage distributions. The highest Nelson-Denny Reading Test grade-equivalent score was grade level fifteen-plus. Two of the textbooks were rated at grade level sixteen, or one grade level above the highest possible Nelson-Denny Reading Test grade equivalent. Reading abilities of 53 students were assessed at grade level fifteen, as were 6 of the textbooks. A total of 264 students read below

grade level fifteen. Nine textbooks matched the reading abilities of 37 students reading at grade level fourteen. A total of 53 students read above grade level fourteen, while 227 read below this grade level. Seven textbooks and 65 students were on grade level thirteen. These textbooks were rated higher than the reading abilities of 162 of the students and lower than 90. None of the textbooks was assessed on grade level twelve. One textbook and 34 students were assessed at grade level eleven. There were 198 students who were rated above grade level eleven, and 85 were determined to read below grade level eleven.

Question 12

Question 12 was stated as follows: What percentages of the students read above, below, or on the same readability level of the textbooks as measured by the Flesch Reading Ease Formula? Table 9 reports the percentages of students reading at the same grade-level placement as the textbooks. Table 10 displays the students' reading-ability scores in a frequency distribution in comparison with the grade-level placement of the textbooks. The Nelson-Denny Reading Test rates no higher than grade level fifteen-plus; therefore, it was not possible to determine the number or percentage of students whose reading abilities exceed grade level fifteen. Two textbooks (13 and 20) were determined to

Table 9

Frequencies and Percentages for the Flesch Reading Ease Formula Grade Equivalents of Textbooks and Scores for Reading Abilities

Grade-Level Placement	Frequency of Textbooks*	Cumulative % of Textbooks	Frequency of Student Scores**	Cumulative Frequency of Students	% of Students
sixteen	2	100.00	--	--	--
fifteen	6	92.00	53	317	16.72
fourteen	9	68.00	37	264	11.68
thirteen	7	32.00	65	227	20.50
twelve	0	--	43	162	13.57
eleven	1	4.00	34	119	10.73
ten	0	--	26	85	8.20
nine	0	--	20	59	6.31
eight	0	--	15	39	4.73
seven	0	--	9	24	2.83
six	0	--	15	15	4.73

*N = 25 textbooks; $\bar{X}$ = 14.00.

**N = 317 students; $\bar{X}$ = 12.23.

Table 10

Readability Levels of the Textbooks, as Measured by the Flesch Reading Ease Formula, Compared with the Reading Achievement Levels of the Students

Grade-Level Placement	Frequency of Student Scores*	Cumulative % of Students	Book Placement**	% of Students Reading Below Textbook Levels
sixteen	--	--	13,20	--
fifteen	53	100.00	8,14,15,19,24,25	83.28
fourteen	37	83.28	2,3,4,6,10,12,18,21,23	71.60
thirteen	65	71.60	1,5,7,9,11,16,22	51.10
twelve	43	51.10	--	--
eleven	34	37.53	17	26.80
ten	26	26.80	--	--
nine	20	18.60	--	--
eight	15	12.29	--	--
seven	9	7.56	--	--
six	15	4.73	--	--

*N = 317 students; $\bar{X}$ = 12.23.

**N = 25 textbooks; $\bar{X}$ = 14.00.

be on grade level sixteen. Six textbooks (8, 14, 15, 19, 24, and 25) and 16.72 percent of the students were assessed at grade level fifteen. A total of 264 students, or 83.28 percent, read below the grade level of these 6 textbooks. There were 9 textbooks (2, 3, 4, 6, 10, 12, 18, 21, and 23) rated at grade level fourteen, and 11.68 percent of the students were rated at this same grade level. Students reading above grade level fourteen totaled 53, or 16.72 percent. Of the 317 students evaluated, 71.60 percent read below grade level fourteen. Seven textbooks (1, 5, 7, 9, 11, 16, and 22) and 20.50 percent of the students were assessed at grade level thirteen. Of the students tested, 51.10 percent read below grade level thirteen, and 28.40 percent of the students were rated above grade level thirteen. One textbook (17) was rated at grade level eleven, while 10.73 percent of the students were rated at this grade level. In all, 62.47 percent of the students read above grade level eleven, while 26.80 percent were rated below grade level eleven, which was the lowest assessment made by using the Flesch formula.

Question 13

Question 13 was stated as follows: How many of the students read above, below, or on the same readability level of the textbooks as measured by the SMOG Grading Formula? Table 11 reports the readability levels

of the textbooks and the reading-ability levels of the students in frequency distributions and percentage distributions. Two textbooks were measured above grade level fifteen, the highest grade-equivalent level possible on the Nelson-Denny Reading Test. One of these textbooks was assessed at grade level seventeen and 1 at grade level sixteen. There were 53 students and 5 textbooks assessed at grade level fifteen. A total of 264 students read below these textbooks. Eight textbooks matched the reading abilities of students reading at grade level fourteen. There were 227 students who read below grade level fourteen, while 53 read above grade level fourteen. Three textbooks and 65 students were assessed at grade level thirteen. A total of 162 students was rated below grade level thirteen, and 90 were rated above it. There were 43 students and 5 textbooks rated at grade level twelve. A total of 119 students was rated below this level, and 155 students were rated above grade level twelve. One textbook, along with 34 students, was rated on grade level eleven. Students reading below grade level eleven totaled 85, and 198 students read above this grade level. There were 26 students and 1 textbook assessed at grade level ten. There were 59 students who read below grade level ten and 232 who read above grade level ten.

Table 11

Frequencies and Percentages for the SMOG Grading Formula Grade Equivalents of Textbooks and Scores for Reading Abilities

Grade-Level Placement	Frequency of Textbooks*	Cumulative % of Textbooks	Frequency of Student Scores**	Cumulative Frequency of Students	% of Students
seventeen	1	100.00	--	--	--
sixteen	1	96.00	--	--	--
fifteen	5	92.00	53	317	16.72
fourteen	8	72.00	37	264	11.68
thirteen	3	40.00	65	227	20.50
twelve	5	28.00	43	162	13.57
eleven	1	8.00	34	119	10.73
ten	1	4.00	26	85	8.20
nine	0	--	20	59	6.31
eight	0	--	15	39	4.73

Table 11 (continued)

Grade-Level Placement	Frequency of Textbooks*	Cumulative % of Textbooks	Frequency of Student Scores**	Cumulative Frequency of Students	% of Students
seven	0	--	9	24	2.83
six	0	--	15	15	4.73

*N = 25 textbooks; $\bar{X}$ = 13.60.

**N = 317 students; $\bar{X}$ = 12.23.

Question 14

Question 14 was stated as follows: What percentages of the students read above, below, or on the same readability level of the textbooks as measured by the SMOG Grading Formula? Table 11, page 68, displays the percentages of students reading on the same grade-level placements as the textbooks. Table 12 presents the students' reading-ability scores in a frequency distribution and a cumulative-percentage frequency distribution in comparison with grade-level placements of the textbooks. Two of the textbooks were rated above grade level fifteen--two grade levels higher than the highest grade equivalent yielded on the Nelson-Denny Reading Test. One of these textbooks (11) was rated at grade level seventeen, and 1 (19) was assessed at grade level sixteen. Five textbooks (1, 5, 12, 14, and 22) were rated at grade level fifteen. Reading on this grade level were 16.72 percent of the students, while 83.28 percent were determined as reading below this grade level. Eight textbooks (2, 3, 7, 16, 17, 18, 20, and 25) were rated at grade level fourteen; while 37 students, or 11.68 percent, read on this level. Reading above grade level fourteen were 16.72 percent of the students, while 71.60 percent read below this grade level. There were 3 textbooks (15, 23, and 24) and 20.50 percent of the students rated on grade level thirteen. Reading above this grade level were 28.40

percent of the students. It was determined that 51.10 percent of the 317 students evaluated read below grade level thirteen. A total of 5 textbooks (4, 8, 9, 10, and 21) was rated at grade level twelve, and 13.57 percent of the students were also rated at this level. Reading above grade level twelve were 48.90 percent of the students, while 37.53 percent read below this grade level. One textbook (13) was assessed at grade level eleven, and 10.73 percent of the students were assessed at this same grade level. The percentage of students reading below grade level eleven was 26.80 percent, while 62.47 percent of the students read above this grade level. One textbook (6) and 8.20 percent of the students were rated at grade level ten. Reading below grade level ten were 18.60 percent of the students, while 73.20 percent of the students read above grade level ten, the lowest grade level yielded by using the SMOG formula.

Question 15

Question 15 was stated as follows: As measured by the Flesch Reading Ease Formula, how many of the students read two or more grade levels below the readability levels of the textbooks, and how many read three or more grade levels below the readability levels of the textbooks? Table 13 reports the number of students who read two or more grade levels below the textbooks and

Table 12

Readability Levels of the Textbooks, as Measured by the SMOG Grading Formula, Compared with the Reading Achievement Levels of the Students

Grade-Level Placement	Frequency of Student Scores*	Cumulative % of Students	Book Placement**	% of Students Reading Below Textbook Levels
seventeen	--	--	11	--
sixteen	--	--	19	--
fifteen	53	100.00	1,5,12,14,22	83.28
fourteen	37	83.28	2,3,7,16,17,18,20,25	71.60
thirteen	65	71.60	15,23,24	51.10
twelve	43	51.10	4,8,9,10,21	37.53
eleven	34	37.53	13	26.80
ten	26	26.80	6	18.60
nine	20	18.60	--	--
eight	15	12.29	--	--

Table 12 (continued)

Grade-Level Placement	Frequency of Student Scores*	Cumulative % of Students	Book Placement**	% of Students Reading Below Textbook Levels
seven	9	7.56	--	--
six	15	4.73	--	--

*N = 317 students; $\bar{X}$ = 12.23. **N = 25 textbooks; $\bar{X}$ = 13.60.

those who read three grade levels or more below the textbooks. A total of 227 students read two or more grade levels below the 2 textbooks rated at grade level sixteen, and 162 students read three or more grade levels below the textbooks rated at grade level sixteen. Six textbooks were rated at grade level fifteen. There were 162 students who read two or more grade levels below the textbooks rated at grade level fifteen and 119 students who read three or more grade levels below the textbooks rated at grade level fifteen. There were 119 students who read two or more grade levels below the 9 textbooks rated at grade level fourteen, while 85 students read three or more grade levels below them. A total of 85 students read two or more grade levels below the 7 textbooks rated at grade level thirteen, while 59 students were rated three or more grade levels below these textbooks. Only 1 textbook was rated at grade level eleven; 39 students read two or more grade levels below this textbook, and 24 students read three or more grade levels below this textbook.

Question 16

Question 16 was stated as follows: As measured by the Flesch Reading Ease Formula, what percentage of the students reads two or more grade levels below the readability levels of the textbooks, and what percentage reads three or more grade levels below the readability

Table 13

Students Reading Below the Readability Levels of the Textbooks as Measured by the Flesch Reading Ease Formula

Grade-Level Placement	Frequency of Students	Students Reading Two or More Grade Levels Below Textbooks	Students Reading Three or More Grade Levels Below Textbooks	Frequency of Textbooks
sixteen	--	227	162	2
fifteen	53	162	119	6
fourteen	37	119	85	9
thirteen	65	85	59	7
twelve	43	--	--	0
eleven	34	39	24	1

levels of the textbooks? Table 14 reports the percentage of students assessed at two or more grade levels below the textbooks and the percentage of students assessed at three or more grade levels below the textbooks. Two textbooks were rated at grade level sixteen; 71.60 percent of the students read two or more grade levels below these textbooks, and 51.10 percent read three or more grade levels below these textbooks. Six textbooks and 16.72 percent of the students were rated at grade level fifteen. Reading two or more grade levels below these 6 textbooks were 51.10 percent of the students. Reading three grade levels or more below grade level fifteen were 37.53 percent of the students. Nine textbooks and 11.68 percent of the students were rated at grade level fourteen. Reading two or more and three or more grade levels below grade level fourteen were 37.53 percent and 26.80 percent of the students, respectively. Seven textbooks and 20.50 percent of the students were assessed at grade level thirteen. Percentages for students reading two or more and three or more grade levels below grade level thirteen were 26.80 percent and 18.60 percent, respectively. One textbook and 10.73 percent of the students were rated at grade level eleven. Reading two or more and three or more grade levels below grade level eleven were 12.29 percent and 7.57 percent of the students, respectively.

Table 14

Percentage of Students Reading Below the Readability Levels of the Textbooks as Measured by the Flesch Reading Ease Formula

Grade-Level Placement	% of Students	% of Students Reading Two or More Grade Levels Below Textbooks	% of Students Reading Three or More Grade Levels Below Textbooks	Frequency of Textbooks
sixteen	--	71.60	51.10	2
fifteen	16.72	51.10	37.53	6
fourteen	11.68	37.53	26.80	9
thirteen	20.50	26.80	18.60	7
twelve	13.57	--	--	--
eleven	10.73	12.29	7.57	1

Question 17

Question 17 was stated as follows: As measured by the SMOG Grading Formula, how many of the students read two or more grade levels below the readability levels of the textbooks, and how many read three or more grade levels below the readability levels of the textbooks? Table 15 displays the students who read two or more and three or more grade levels below the readability levels of the textbooks. One textbook was assessed at grade level seventeen, and 246 students were rated as reading two or more grade levels below this textbook. The reading skills of 227 students were determined to be three or more grade levels below grade level seventeen. There were 227 students who rated two years below grade level sixteen at which 1 textbook was rated, and reading skills of 162 students were assessed three or more grade levels below grade level sixteen. Five textbooks were rated at grade level fifteen, and 162 students read two or more grade levels below these textbooks. There were 119 students who were rated three or more grade levels below grade level fifteen. A total of 119 students was assessed as reading two or more grade levels below the 8 textbooks rated at grade level fourteen. Of the 317 students evaluated, 85 were rated three or more grade levels below grade level fourteen. Three textbooks were rated at grade level thirteen, and 85 students were rated two or more

grade levels below these textbooks. Students rated three or more grade levels below grade level thirteen numbered 59. Five textbooks were rated at grade level twelve. There were 59 students who were rated two or more grade levels below grade level twelve and 39 who were rated three or more grade levels below this level. A total of 39 students was rated two or more years below the 1 textbook that was rated at grade level eleven, while 24 students were rated three or more grade levels below grade level eleven. One textbook was rated at grade level ten, and 24 students were rated two or more grade levels below. It was determined that 15 students read three or more grade levels below grade level ten.

Question 18

Question 18 was stated as follows: As measured by the SMOG Grading Formula, what percentage of the students reads two or more grade levels below the readability levels of the textbooks, and what percentage reads three or more grade levels below the readability levels of the textbooks? Table 16 reports the percentage of students reading two or more grade levels below the textbooks and the percentage of students reading three or more grade levels below the textbooks. One textbook was rated at grade level seventeen; 83.28 percent of the students read two or more grade levels below this

Table 15

Students Reading Below the Readability Levels of the Textbooks as Measured by the SMOG Grading Formula

Grade-Level Placement	Frequency of Students	Students Reading Two or More Grade Levels Below Textbooks	Students Reading Three or More Grade Levels Below Textbooks	Frequency of Textbooks
seventeen	--	246	227	1
sixteen	--	227	162	1
fifteen	53	162	119	5
fourteen	37	119	85	8
thirteen	65	85	59	3
twelve	43	59	39	5
eleven	34	39	24	1
ten	26	24	15	1

textbook, and 71.60 percent were rated three or more grade levels below grade level seventeen. Rated at grade level sixteen was 1 textbook, and 71.60 percent of the students were assessed as reading two or more grade levels below this textbook. Reading three or more grade levels below grade level sixteen were 51.10 percent of the subjects. Five textbooks and 16.72 percent of the students were rated at grade level fifteen. The percentage of students reading two or more grade levels below grade level fifteen was 51.10 percent, and the percentage of students reading three or more grade levels below grade level fifteen was 37.53 percent. Reading two or more grade levels below the 11.68 percent of the students rated at grade level fourteen were 37.53 percent of the 317 students tested. Eight textbooks were determined to be at grade level fourteen, and 26.80 percent of the students were rated three or more grade levels below these textbooks. Three textbooks were rated at grade level thirteen, and 26.80 percent of the students read two or more grade levels below these textbooks. Rated three or more grade levels below grade level thirteen were 18.60 percent of the students. Five textbooks and 13.57 percent of the students were rated at grade level twelve. A total of 18.60 percent of the students read two or more grade levels below grade level twelve, and reading three or more grade levels below grade level twelve were 12.29 percent of

Table 16

Percentage of Students Reading Below the Readability Levels of the Textbooks as Measured by the SMOG Grading Formula

Grade-Level	% of Students	% of Students Reading Two or More Grade Levels Below Textbooks	% of Students Reading Three or More Grade Levels Below Textbooks	Frequency of Textbooks
seventeen	--	83.28	71.60	1
sixteen	--	71.60	51.10	1
fifteen	16.72	51.10	37.53	5
fourteen	11.68	37.53	26.80	8
thirteen	20.50	26.80	18.60	3
twelve	13.57	18.60	12.29	5
eleven	10.73	12.29	7.56	1
ten	8.20	7.56	4.73	1

the students. One textbook and 10.73 percent of the students were rated at grade level eleven. Reading two or more grade levels below grade level eleven were 12.29 percent of the students, and reading three or more grade levels below grade level eleven were 7.56 percent of the students. One textbook and 8.20 percent of the students were rated at grade level ten. The percentage of students reading two or more grade levels below grade level ten was 7.56 percent, and 4.73 percent of the students read three or more grade levels below this grade level.

DIFFERENCES BETWEEN THE TEXTBOOK READABILITY LEVELS OF THE FLESCH READING EASE FORMULA AND THE SMOG GRADING FORMULA

In order to determine the difference between the mean readability level of the textbooks as assessed by the Flesch formula and the mean readability level of the textbooks as measured by the SMOG formula, the t-test for independent samples was used to calculate the values by utilizing the formula given in the Cheat Sheet for Stat (Cochran and Holliman, 1975:24-25). Table 17 reports the t-test result, along with the standard deviations for the Nelson-Denny Reading Test, the Flesch formula, and the SMOG formula. The Nelson-Denny Reading Test standard deviation was 2.43. The Flesch formula showed a standard deviation of 1.12, and

the SMOG formula showed a standard deviation of 1.61.

Table 17

Standard Deviations on the Nelson-Denny Reading Test, Flesch Formula Scores, and SMOG Formula Scores; and the t-test Score for Flesch and SMOG

Instrument	S.D.	t-test Ratio for Independent Samples
Nelson-Denny Reading Test	2.43	
Flesch Reading Ease Formula	1.12	
SMOG Grading Formula	1.61	
Flesch and SMOG		1.02

TESTING OF THE HYPOTHESIS

The hypothesis formulated for this study stated that there is no statistically significant difference between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula. Table 17 reports the t-test ratio for independent samples and standard deviations. The t-test ratio value for the Flesch formula and the SMOG formula was 1.02, which was not significant at the .05 level of confidence; therefore, the hypothesis was not rejected.

There was a .40 grade level difference between

the means of the Flesch formula and the SMOG formula, which was not considered to be statistically significant. Table 18 displays the differences noted between formulas. The Flesch formula assessments correspond with the SMOG formula ratings of 7 textbooks. The following differences between assessments of the two formulas were observed: a difference of one grade level was noted between the ratings of 11 textbooks, a difference of two grade levels was reported for 3 of the textbooks, a difference of three grade levels was reported for 3 of the textbooks, and there was a difference of four grade levels between the assessments of 1 textbook.

Where differences between the assessments of the formulas were observed, in twelve of the eighteen differences, the Flesch formula yielded the higher rating. Table 18 reports which formula gave the higher rating. Where a difference of one grade level was noted, the Flesch formula yielded higher assessments for 7 textbooks, and the SMOG ratings were higher for 4 textbooks. The Flesch ratings were always higher where there was a difference of two grade levels. Where a difference of three grade levels was reported, the Flesch formula rated 1 higher, and the SMOG rated 2 higher. In the case of a difference of four grade levels, the Flesch rating was higher for the 1 textbook involved.

Table 18

Differences Between the Grade Equivalent Assessments of the Flesch Reading Ease Formula and the SMOG Grading Formula

Difference in Grade Levels	Number of Textbooks	Flesch Higher	SMOG Higher
No Difference	7	--	--
One Grade	11	7	4
Two Grades	3	3	0
Three Grades	3	1	2
Four Grades	1	1	0
Totals	25	12	6

Chapter 5

SUMMARY, FINDINGS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The purpose of this chapter is threefold: to report the findings of this investigation, to present the conclusions and implications derived from these findings, and to recommend areas for future research. In order to accomplish this, the following sections are included: a summary, the findings of the study, conclusions drawn from the findings, implications of the findings, and recommendations.

SUMMARY

It has been determined that the majority of college courses have required textbooks. The importance of the students' abilities to utilize them effectively has been stressed throughout this investigation. The reviewed research cites the problems encountered by the student when the textbooks are above the student's reading capability. Textbooks which are above the reading abilities of the students can cause anxiety, frustration, and failure. The selection of textbooks appropriate to the reading skills of the students has been emphasized. It has been shown that textbooks commensurate with students'

reading abilities can alleviate some of the problems which confront both students and educators who utilize textbooks in the learning-teaching process. The use of readability formulas as instruments in textbook selection has been expounded.

This study was designed to describe the differences between the reading-difficulty levels of twenty-five primary textbooks used in first-semester freshman General Studies courses and the reading skills of the students enrolled in those courses. The questions described the differences between the reading proficiencies of 317 first-semester freshmen who constituted the sample, as measured by the Nelson-Denny Reading Test, Form C, and the readability levels of the textbooks used in first-semester freshman General Studies courses, as measured by the Flesch Reading Ease Formula and the SMOG Grading Formula. Examined were the numbers and percentages of students and textbooks rated at each grade level, with particular emphasis being placed on the numbers and percentages of students rated two or more and three or more grade levels below grade level thirteen and the numbers and percentages of students reading two or more and three or more grade levels below the textbooks. The measures of central tendency--the arithmetic mean, median, and mode--were determined for the scores yielded by the Nelson-Denny Reading Test, the Flesch Reading Ease Formula, and the SMOG Grading

Formula. Tables and frequency distributions were utilized to display these statistics.

A secondary purpose of this investigation was to compare the Flesch Reading Ease Formula with the SMOG Grading Formula. This comparison was made in order to determine if there was any statistically significant difference between the mean readability scores of the two formulas. This was done in order to ascertain the feasibility of employing the SMOG formula as a useful readability tool. The Flesch formula has a reputation of being a widely used and reliable tool, while the SMOG formula is a relatively new formula that has seen limited usage.

The hypothesis tested in this investigation is as follows: There is no statistically significant difference between the grade readability level of the textbooks as measured by the Flesch Reading Ease Formula and the grade readability level of the textbooks as measured by the SMOG Grading Formula. A summary of the testing results is given in the paragraphs which follow.

The mean readability levels of the textbooks as measured by the Flesch formula and the SMOG formula were 14.00 and 13.60, respectively. The hypothesis was not rejected at the .05 level of confidence. The *t*-ratio value of 1.02 for independent samples was not statistically significant. The difference between the two readability formulas, the Flesch formula and the SMOG

formula, could have happened by chance.

There was a .40 grade-level difference, which was not statistically significant, between the means of the Flesch formula and the SMOG formula. The Flesch formula ratings matched the SMOG formula ratings of 7 textbooks. The following differences between the assessments of the two formulas were observed: a difference of one grade level was noted between 11 of the textbooks, a difference of two grade levels was observed between 3 of the textbooks, a difference of three grade levels was reported for 3 of the textbooks, and a difference of four grade levels was made for 1 textbook (see Table 18, page 86).

Where differences between the assessments of the formulas were observed, in twelve of the eighteen differences the Flesch formula yielded the higher rating. Where a difference of one grade level was noted, the Flesch formula yielded higher scores for 7 textbooks, and the SMOG ratings were higher for 4 textbooks. The Flesch ratings were always higher where there was a difference of two grade levels. Where a difference of three grade levels was observed, the Flesch formula rated 1 higher, and the SMOG rated 2 higher. In the case of a difference of four grade levels, the Flesch rating was higher for the 1 textbook involved.

FINDINGS

The data presented in this descriptive investigation revealed the following:

1. A total of 65 students, or 20.50 percent of the 317 students evaluated in the study, read at grade level thirteen. There were 162 students, or 51.10 percent, who read below grade level thirteen; 90 students, or 28.40 percent, who read above grade level thirteen; and 155 students, or 48.90 percent, who read at or above grade level thirteen.

2. Of the 317 first-semester freshmen tested, students reading two or more grade levels below grade level thirteen numbered 85 and constituted 26.80 percent of the subjects. According to the data, 59 of these 317 students, comprising 18.60 percent, were rated three or more grade levels below grade level thirteen.

3. The textbooks ranged from grade level eleven to grade level sixteen as measured by the Flesch Reading Ease Formula and ranged from grade level ten to grade level seventeen as measured by the SMOG Grading Formula. None of the textbooks was rated below grade level ten, and only 1 book was rated at that level. The Flesch formula rated 2 textbooks at grade level sixteen, 6 at grade level fifteen, 9 at grade level fourteen, 7 at grade level thirteen, and 1 at grade level eleven. The SMOG formula textbook assessments were as follows: 1 each

at grade levels seventeen and sixteen, 5 at grade level fifteen, 8 at grade level fourteen, 3 at grade level thirteen, 5 at grade level twelve, and 1 each at grade levels eleven and ten.

4. The students' mean reading-ability score on the Nelson-Denny Reading Test was 12.23. The means for the twenty-five textbooks were 14.00 according to the Flesch formula and 13.60 according to the SMOG formula.

5. Of the 317 first-semester freshmen tested, 119, or 37.53 percent, read two or more grade levels below the mean readability level of the Flesch formula. Reading three or more grade levels below the Flesch mean readability level were 85 of the students, or 26.80 percent. Reading two or more grade levels below the SMOG mean of 13.60 were 85 students, or 26.80 percent; and 59, or 18.60 percent of the 317 students, read three or more grade levels below the SMOG mean.

6. The students' mean reading-proficiency score of 12.23 was determined to be close to the reading level expected of first-semester freshman students. Reading at grade level twelve and above were 62.47 percent of the students.

7. The majority of the textbooks used in the first-semester freshman General Studies courses were rated higher than the reading abilities of the students enrolled in those courses. In all, 96.00 percent of

the textbooks were rated above the mean reading-ability level of the students as measured by the Flesch formula, and 72.00 percent of the textbooks were rated above the mean reading-ability level of the students as measured by the SMOG formula.

8. No statistically significant difference was detected between the mean readability scores of the Flesch Reading Ease Formula and the SMOG Grading Formula. The differences between the two readability formulas could have occurred by chance.

CONCLUSIONS

The following conclusions are based on the findings of this investigation:

1. The mean reading-ability level of the students is not significantly below the reading-ability level expected of entering freshmen.

2. The reading abilities of the freshman students are not commensurate with the reading difficulty of the textbooks used in their courses.

3. Most of the instructors in the General Studies courses do not know the readability levels of their textbooks and the reading abilities of their students.

4. Most instructors do not know the problems students encounter with textbooks which are written on a level higher than the students are capable of reading

independently.

5. The reading-ability levels of students can vary to a large degree within a class.

6. Textbooks have been selected without regard for the reading abilities of the students who use them.

7. Readability data for textbooks are not readily available to instructors who have the task of textbook selection.

8. Textbook authors and publishers should be concerned with keeping the readability levels of textbooks within the grade levels for which the textbooks are intended.

9. The SMOG Grading Formula is a reliable readability instrument for assessing the readability levels of college textbooks.

10. Of the entering freshmen, 18.60 to 26.80 percent are classified as disabled readers.

IMPLICATIONS

The ramifications of 18.60 percent to 26.80 percent of the entering freshman class not being capable of reading college-level textbooks are far reaching. Assuming that reading is an integral part of college work, the students who have been identified as reading two to three years or more below the level expected of college freshmen can be considered as disabled readers. Disabled readers stand little chance of completing a

college degree. Because these students are not equal to the reading tasks required of them in college, much thought should be given to providing adequate reading instruction before they enter college. Ulman (1969:558) cited a study by Lloyd which found:

> . . . evidence that reading deficiencies found at the sixth grade . . . had existed for several grades and, on the basis of sixth-grade underachievement, it was possible to predict academic performance in high school and beyond.

Reading instruction should be continued through the secondary level rather than being discontinued upon completion of junior high school or middle school, as is the current practice. Universities, once having accepted the student and having received his money, should afford the student the opportunity to acquire those reading skills vital to academic success through remedial reading programs.

This investigation revealed that the majority of the textbooks used in first-semester freshman General Studies courses were written on a level significantly above the reading-ability levels of the students who were to use them. The literature on reading ability and readability is replete with evidence of the student's inability to comprehend his textbook and his resulting failure, whether the student was not reading up to his expected grade level or because the textbook was written on a level higher than the expected reading-ability level of the student for whom the textbook was intended.

Students who read below the instructional readability level of the textbooks cannot be expected to effectively utilize their textbooks and, as a result, will experience failure. The literature reviewed in this study cites consistently the lack of consideration given to the readability of textbooks in relation to the reading abilities of the students. The literature reviewed and the findings of this investigation suggest that the readability of textbooks should be a consideration in the textbook-selection process.

RECOMMENDATIONS

The following recommendations are based on the statistical results of this descriptive study:

1. A diagnostic screening program designed to identify those students whose reading abilities are below the instructional reading level expected for academic success should be instituted. Although the mean reading-proficiency score of the students is higher than those reported in other studies, the reading-ability scores ranged from grade level six to grade level fifteen-plus.

2. A developmental and remedial reading program specifically designed to help students acquire those reading skills necessary for academic success should be implemented.

3. The readability levels of textbooks in

relation to the reading abilities of the students should be a consideration in the textbook-selection process. Textbooks which are written two or more grade levels above the student's reading-ability level are too difficult for him to read--even with assistance.

4. The SMOG Grading Formula should be utilized as a readability instrument for assessing the readability levels of college-level textbooks. It is an easy formula to employ, requiring about ten minutes to determine the readability level of a book. No statistically significant difference was found between it and the Flesch Reading Ease Formula. The differences between the two formulas could be attributed to the different factors used to determine the readability levels of textual materials.

5. A duplication of this study at other regional universities should be conducted in order to determine the profiles of students' reading abilities and the readability of the textbooks they use.

6. A year-to-year replication of the student-assessment portion of this study should be conducted in order for the institution used in this study to know the reading abilities of its students.

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THE FLESCH READABILITY FORMULA

Step 1. Pick your samples

Go by a strictly numerical scheme. For instance, take every third paragraph or every other page. Each sample should start at the beginning of a paragraph.

Step 2. Count the number of words

Take each sample and count each word in it up to 100. Count contractions and hyphenated words as one word. Count numbers and letters as words, too, if separated by spaces. For example, count each of the following as one word: 1948, $19, 892, e.g., C.O.D., wouldn't.

Step 3. Figure the average sentence length

Figure the average sentence length in words for your piece of writing. If you are using samples, do this for all your samples combined. In a 100-word sample, find the sentence that ends nearest to the 100-word mark--that might be at the 94th word or the 109th. Count the sentences up to that point and divide the number of words in those sentences in your samples. In counting sentences, follow the units of thought rather than the punctuation: usually sentences are marked off by periods; but sometimes they are marked off by colons or semicolons--like these. (There are three sentences here between two periods.) But don't break up sentences that are merely joined by conjunctions

like and or but.

Step 4. Count the syllables

Count the syllables in your 100-word samples and divide the total number of syllables by the number of samples. This will give you the number of syllables per 100 words. If in doubt about syllabication rules, use any good dictionary.

Step 5. Count the "personal words"

Count the "personal words" in your 100-word samples and divide the total number of "personal words" by the number of samples. This will give you the number of "personal words" per 100 words. "Personal words" are:

(a) All first-, second-, and third-person pronouns except the neuter pronouns it, its, itself, and they, them, their, theirs, themselves if referring to things rather than people;

(b) All words that have masculine or feminine natural gender, e.g., John Jones, Mary, father, sister, iceman, actress. Do not count common-gender words like teacher, doctor, spouse.

Step 6. Count the "personal sentences"

Count the "personal sentences" in your 100-word samples and divide the number of "personal sentences" in all your samples by the number of sentences in all your samples. This will give you the number of "personal sentences" per 100 sentences. "Personal sentences" are:

(a) Spoken sentences, marked by quotation marks or otherwise, often including speech tags like "he said," set off by colons or commas (e.g., "I doubt it."--We told him: "you can take it or leave it;"

(b) Questions, commands, requests, and other sentences directly addressed to the reader (e.g., Does this sound impossible?--Imagine what that means.) But do not count sentences that are only indirectly or vaguely addressed to the reader (e.g., This is typical of our national character.--You never can tell.);

(c) Exclamations (e.g., It's unbelievable!);

(d) Grammatically incomplete sentences whose full meaning has to be inferred from the context (e.g., Handsome, though.).

Step 7. Find your "reading ease" score

Using the average sentence length in words (step 3) and the number of syllables per 100 words (step 4), find your "reading ease" score on the How Easy? chart constructed by Flesch. Or you can use this formula:

Multiply the average sentence length by 1.015	_____
Multiply the number of syllables per 100 words by .846	_____
Add	
Subtract this sum from	206.835
Your "reading ease" score	_____

The "reading ease" score will put your piece of writing on a scale between 0 (practically unreadable) and 100 (easy for any literate person).

Step 8. Find your human interest score

Using the number of "personal words" per 100 words (step 5) and the number of "personal sentences" per 100 sentences (step 6), find your "human interest" score on the How Interesting? chart constructed by Flesch. Or you can use this formula:

Multiply the number of "personal words" per 100 by 3.635 _____
Multiply the number of "personal sentences" per 100 sentences by .314 _____
The total is your "human interest" score _____

The scale will range from 0 to 100.

Formula for Flesch Readability

R.E. = 206.835 - .846 wl - 1.015 sl

H.I. = 3.635 pw + .314 ps

Key

R.E. = Reading Ease

H.I. = Human Interest

sl = sentence length

wl = number words per sentence

pw = personal words per 100 words

ps = personal sentences per 100 sentences

The "human interest" score gives an estimate of the attractiveness of the writing. The more human interest for a book--the better.

Equivalent Grade Levels

Description of Style	Average Sentence Length	Average no. of Syllables per 100 wds.	Reading Ease Score	Estimated Reading Grade
Very easy	8 or less	123 or less	90-100	5th grade
Easy	11	131	80-90	6th grade
Fairly easy	14	139	70-80	7th grade
Standard	17	147	60-70	8th-9th
Fairly difficult	21	155	50-60	10th-12th
Difficult	25	167	30-50	13-16 (college)
Very difficult	29 or more	192 or more	0-30	college graduate

THE SMOG FORMULA

Step 1

Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end. Count as a sentence any string of words ending with a period, question mark or exclamation point.

Step 2

In the 30 selected sentences count every word of three or more syllables. Any string of letters or numerals beginning and ending with a space or punctuation mark should be counted if you can distinguish at least three syllables when you read it aloud in context. If a polysyllabic word is repeated, count each repetition.

Step 3

Estimate the square root of the number of polysyllabic words counted. This is done by taking the square root of the nearest perfect square. For example, if the count is 95, the nearest perfect square is 100, which yields a square root of 10. If the count lies roughly between two perfect squares, choose the lower number. For instance, if the count is 110, take the square root of 100 rather than that of 121.

Step 4

Add 3 to the approximate square root. This gives the SMOG Grade, which is the reading grade that a person must have reached if he is to understand fully the text assessed.

APPENDIX D

INTERPOLATION OF FLESCH SCORES

Equivalent Grade Levels

Description of Style	Average Sentence Length	Average no. of Syllables per 100 wds.	Reading Ease Score	Estimated Reading Grade
Very easy	8 or less	123 or less	90-100	5th grade
Easy	11	131	80-90	6th grade
Fairly easy	14	139	70-80	7th grade
Standard	17	147	60-70	8th-9th
Fairly difficult	21	155	50-60	10th-12th
Difficult	25	167	30-50	13-16 (college)
Very difficult	29 or more	192 or more	0-30	college Graduate

Table 19

Flesch Scores Interpolated

Reading Ease Score	Flesch Grade Equivalent	Interpolated Grade Equivalent
30-34	13-16	16
35-39	13-16	15
40-44	13-16	14
45-50	13-16	13
51-54	10-12	12
53-56	10-12	11
57-60	10-12	10

Table 20

Flesch Readability Assessments

Textbook	Reading Ease Score	Flesch Grade Equivalent	Interpolated Grade Equivalent
1	43	13-16	14
2	41	13-16	14
3	42	13-16	14
4	47	13-16	13
5	43	13-16	14
6	50	13-16	13
7	37	13-16	15
8	48	13-16	13
9	44	13-16	14
10	49	13-16	13
11	43	13-16	14
12	30	13-16	16
13	39	13-16	15
14	36	13-16	15
15	45	13-16	13
16	55	10-12	11
17	43	13-16	14
18	38	13-16	15
19	32	13-16	16
20	42	13-16	14
21	46	13-16	13

Table 20 (continued)

Textbook	Reading Ease Score	Flesch Grade Equivalent	Interpolated Grade Equivalent
22	43	13-16	14
23	35	13-16	15
24	35	13-16	15
25	49	13-16	13